The Times HISTORY AND ENCYCLOPÆDIA OF THE WAR

FRENCH FIELD HOSPITAL IN A CHURCH.

PRICE NET 7D
PUBLISHED WEEKLY

Shell Shock and Nervous Injuries.

PART 87
VOL. 7. APR. 18, 1916.

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CHAPTER CXVII.

THE MENTAL FACTOR IN MODERN WAR: SHELL SHOCK AND NERVOUS INJURIES.

NEW PROBLEMS OF MENTAL STRAIN—FIRST APPEARANCE OF "SHELL SHOCK"—EFFECT OF THE HIGH EXPLOSIVE SHELL—"RESISTANCE" DEPENDENT ON TRAINING AND HEALTH—STRANGE PHENOMENA OF MENTAL BREAKDOWN—LOSS OF MEMORY—TEMPORARY DUMBNESS AND BLINDNESS—SCIENTIFIC OPINIONS—PRECAUTIONS AND TREATMENT OF "SHELL SHOCK"—THE MENTAL TREATMENT BILL—SPECIAL HOSPITAL WORK IN ENGLAND—REST CAMPS—BATHS AT THE FRONT—"TRENCH-FOOT"—THE DISEASE AND ITS CURE—"SOLDIER'S HEART"—RESEARCH WORK—GAS POISONING AND ITS CURE—AFTER-TREATMENT OF FACE INJURIES AND PREVENTION OF DEFORMITY—THE WORK OF THE DOCTORS.

THE effect of war upon the fighting man has always been difficult to estimate, and it is probably true that the whole effect, moral and mental as well as physical, never has been estimated. Yet in all the wars of the past certain broad results have been noted and commented upon.

These results were chiefly physical and were recorded much as the discharges from a great hospital are recorded. The mental factor in war was, generally, not a very important one, or it was very badly understood. A certain proportion of soldiers broke down mentally, but this proportion was so small when compared with the proportion of wounded, and still more of sick, that it was regarded as being negligible. Thus the medical records which tell the whole story of outbreaks of plague and pestilence devote but scant attention to the mind of the fighting man.

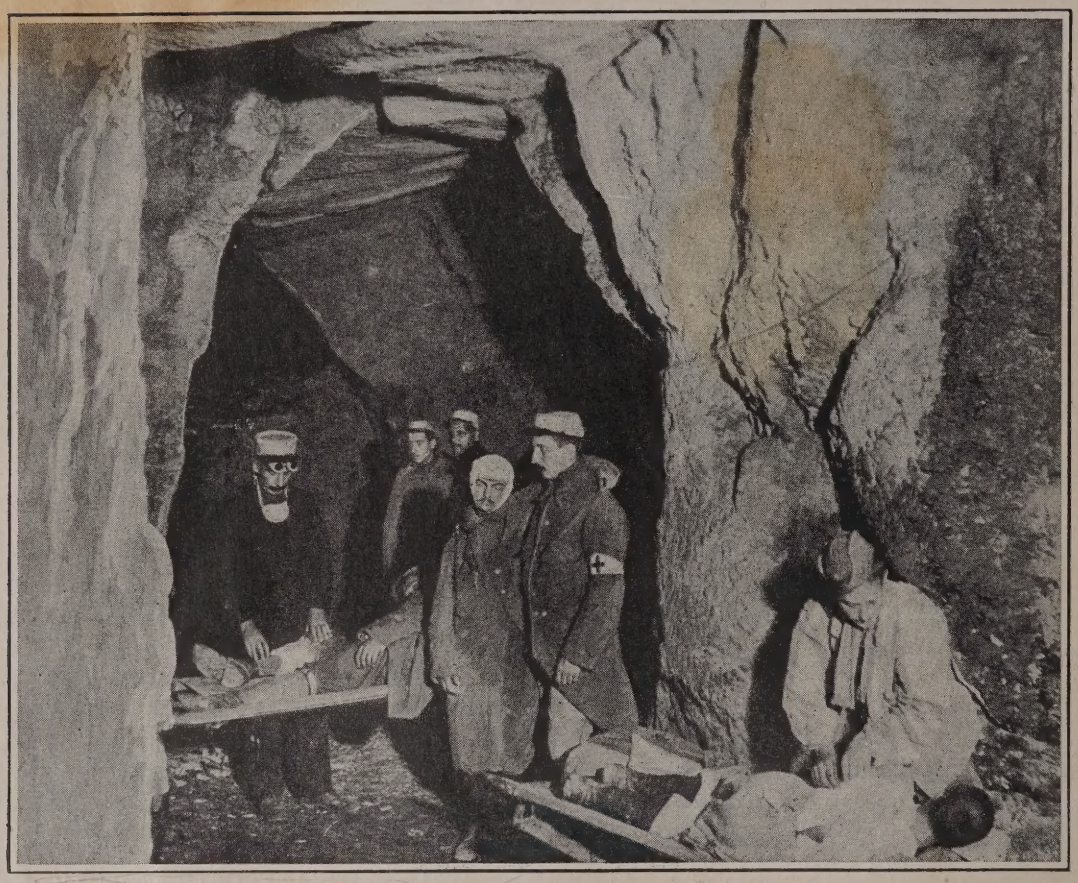
It is not possible to feel surprised at this when one remembers that in the wars of the past the great problem which the doctors had to face was the problem of infectious disease. They had, literally, no time for any other matters. Epidemics always sprang up, and what with the sick and wounded the medical staff had its hands very full indeed.

The Great War was in a category by itself so far as medical matters were concerned. In the first place the advance of surgery had rendered the treatment of wounds a much easier matter, in the second the help of science ensured that treatment would be undertaken with good prospect of success. Again, science had met and defeated the principal epidemic, typhoid fever, and had thus rid the armies of their worst enemy. The strain upon the medical service was greatly reduced.

But the medical service itself was a very different body from the medical services of the old days. It had become, quite early in the war, a vast organization of the best medical and scientific ability in the country, an organization even in its humblest ranks of picked men.

This organization included specialists in almost every department of medicine. These men were enabled to deal with the fallen and wounded soldier not as a mere unit but rather as a patient. They had opportunity afforded them for that careful scientific work which is so essential to correct treatment. They were able to study their patients, so that from study better lines of treatment might be arrived at.

The war had scarcely begun before it was seen that the specialist would be called upon to play



FRENCH RED CROSS STATION IN A CAVE.
Rendering first aid to the wounded as they are brought from the trenches.

a great part in the solution of its medical problems. This was very apparent in regard to the poisoned wounds which began to show themselves in such terrible abundance; it was no less apparent in regard to the nervous affections which resulted from the explosion of heavy shells.

These nervous affections indeed constituted a huge problem from the very outset. They were exceedingly frequent, exceedingly varied, and exceedingly severe. They represented a phenomenon which, if it was not new, was, at any rate, very unfamiliar to the majority of the doctors who encountered it. In the wars of the past a certain amount of trouble had arisen as the result of the explosions of shells, but this trouble had never been of a really serious character. Here, on the contrary, was a force which killed without injuring, which seemed to unseat the mind itself, and to deprive a man of all his faculties while yet not a scratch could be detected upon his skin.

The first warning of a really impressive kind which the world received regarding this new and terrible factor in warfare came in the form of a strange rumour which was in circulation at the time of the Battle of the Marne. The rumour had several forms, but in its essence it told the same story. Dead men, it said, had been found standing in the trenches, apparently in possession of their faculties. Every normal attitude of life was imitated by these dead men; their bodies were found posed in all manner of positions, and the illusion was so complete that often the living would speak to the dead before they realized the true state of affairs.

When this rumour first became current, the explanation was offered that these men had been "asphyxiated" by a new type of shell. The explanation revealed the fact that at that period a purely physical reason was regarded as necessary; doctors and the public at large had not then taken into consideration the possibility that the cause of death might be mental rather than physical.

The asphyxia explanation did not survive long, for soon a great deal of new evidence regarding the effects of high explosive shells accumulated. Thus men were brought down

to the base in the state known as the state of shock. These men presented very much the appearance of severely wounded men, only in this case no wound could be discovered. Every medical man who had given anæsthetics and watched his patients after their recovery from operation knew this state and knew something about it.

But, in addition to the cases of shock, there were found cases in which disease pictures were represented, but in which no actual disease could be detected, and it was observed that, almost without exception, the men so affected had been exposed to the effects, either immediate or more remote, of high explosive shells.

From this time onwards interest in the nervous affection of battle became profound. Neurologists were attached to the military hospitals, and nerve cases were studied as closely and as carefully as were surgical and medical cases. It was realized that the coming of the high explosive shell to the front place among the weapons of war had wrought a revolution in the types of war injuries, and so in war medicine. It became quite clear that vast numbers of men would be smitten down by the "invisible force," and that the future of these men must depend almost wholly upon the degree of knowledge of the conditions possessed by their doctors and upon the degree of enlightenment of the authorities controlling their destinies.

It was recognized from the first that the condition of shell shock was no simple one, but that very many complex factors were involved. The growth of knowledge of the subject very soon set all doubt about this at rest. One of the first observations made was that liability to shell shock or to nervous injury was by no means the same in every individual, indeed that it differed in the same individual at different times and in different conditions. Wellington's famous remark about "four o'clock in the morning courage" seemed thus to find a new application. Amongst the determining factors were the force of the explosion, the length of time during which the soldier had been exposed to shell fire, the length of time during which he had been under fire at all—*i.e.*, the

AFTER A BATTLE IN CHAMPAGNE.
German wounded waiting for an ambulance to take them off the battle-ground.

REMOVING THE WOUNDED UNDER FIRE.

degree of his experience of war, the state of the weather, the state of the campaign, the man's own health, his physical well-being, his food, his sleep, and finally his history, both personal and family.

These observations opened up a very wide vista indeed, and called for immediate and careful investigation. The first point, clearly, which had to be determined was the type of soldier who was most subject to the effects of the shock and the type of conditions in which he was most subject. The investigation was carried out by many workers, and their results were found to agree in the main particulars.

First it became clear that the experienced soldier was less liable than his inexperienced fellow, so long as the conditions surrounding him came within his experience. This was not perhaps surprising in view of the well-known effects of discipline and the equally well-known value of old and seasoned troops as against raw levies, though it remained a matter of great interest that discipline and seasoning were able to confer immunity of a kind against so violent an assault as that of a bursting shell.

The next difference which was observed was that existing between men of sound history and men in whose history there were flaws of one kind or another. Investigation along this line soon brought to light the fact that a very considerable number of the cases of shell shock occurred in individuals of a neuropathic or psychopathic predisposition or of a nervous or timorous disposition.

It became clear that the term "resistance" as applied to man has a much wider significance than had hitherto been supposed—that, in fact, resistance is a quality of the whole organism, always active and determining the course of every reaction.

Further, a curious relationship between the events of war and the incidence of shell shock was established, and it was found that a happy, or a hopeful, army is, as a unit, less subject to this condition than an overwrought, unsuccessful or disappointed one. Thus Major Mott stated in a lecture before the Royal Society of Medicine that it had appeared to him that the cases of shell shock in 1916 were less severe than those met with in the spring of 1915. He added: "I attribute this to the fact that life in the trenches has not been associated with such continuous and severe nervous strain and fearful apprehension. Our men have felt that in numbers and in effectiveness of our artillery the balance of power is no longer with the enemy. The joy of hope has replaced the depression of fear."

A speaker who followed him pointed out, further, that it was a curious fact that very few

cases of mental breakdown seemed to have occurred among the troops at Gallipoli at the time of the first landing, in spite of the awful slaughter. During the first two or three weeks after this landing he saw only about half a dozen cases of nervous breakdown in the seventeenth General Hospital at Alexandria. No doubt this was due to the protective influence of the sthenic emotions which actuated almost all the men at the time.

Shell shock, then, was seen to be the end rather than the beginning of a process. In some instances it was the culminating stage in a nervous life-history; in other cases it was the expression of physical bankruptcy. In all cases its occurrence was favoured by those circumstances which, generally, favour the onset of ill-health.

The fact that the war was being waged largely by means of high explosive shells made these observations exceedingly important, as will presently be shown.

The condition itself was so remarkable and so interesting as to merit a careful description. Its onset was determined as a rule by heavy gunfire or by the bursting of a shell in the neighbourhood of the affected man, though such a history could not always be obtained. Occasionally the victim had been buried by the shell. In these cases of burying, where presumably some actual concussion took place,

THE RETURN OF STRENGTH.
One crutch has been taken away.

the state known as "retrograde amnesia," or loss of memory extending back beyond the shock, perhaps far beyond it, was observed. Retrograde amnesia was not seen in cases in which no physical damage had occurred, in these memory-loss dated from the event. The immediate effect was almost always loss of consciousness. This loss of consciousness lasted for a long time or a short time. It affected the intellect rather than the functions of the brain which have regard to the preser-

MECHANO-THERAPEUTICS AT RENNES.
A repair-shop for wounded men.

A RUSSIAN RED CROSS HOSPITAL.

(1) The Czarina and the Grand Duchesses Olga (2) and Tatiana (3) with the wounded.

vation of the individual and the species. Dr. Mott described the case of an officer whose company had dug themselves in, in a wood; he went out into the road to see if a convoy was coming. A large shell burst near him. It was about two o'clock in the morning, and quite dark. About 4.30 a.m. it was light, and the officer found himself being helped off his horse by two women who came out of a farm house. He had no recollection of anything that happened between the bursting of the shell and this incident.

In this state memory might be completely lost, so that the soldier's face was a blank. He might not remember his name; he might have no idea who he was, or how he came to be in the position in which he found himself. Near relations who visited him often found that he had no idea regarding their identity, and viewed their coming with the same stony indifference with which he regarded the whole world around him. No matter what his aptitudes and tastes might have been before the shock occurred, he lost them. One soldier, for example, was found to be unable to give any account of himself. When his name was written he did not recognize it; he did not know the season of the year. He did not recollect anything that was told him, so that his memory for recent events, as well as for the past, was lost.

Another man had been a good musician. He was asked by the doctor to sing. He failed to do this, and the doctor then began to whistle "God Save the King." The patient looked up and finished the tune. He was then invited to whistle "Tipperary," and did so on being started. From this time his expression changed—his mind had found itself. He could now whistle any of the tunes he had previously been started on. Later he began to play the piano.

It was found that the musical memory tended to return sooner than did the memory of events and persons, probably because the emotional effect of music fixed impressions upon the mind very firmly, and these impressions were therefore more easily brought again into consciousness.

In another class of case the soldier retained a very clear recollection of the event, or events, which took place at the moment when he received his shock. Thus he might be haunted by terrible visions of carnage, visions in which "flying legs and arms" figured prominently. In these cases terrifying dreams played a prominent part in the mental picture.

Men became dumb within an hour, yet many of these dumb men recovered speech almost as instantaneously as they had lost it. Written speech and silent thought, the visualisation of words, were always intact. In one case a man's companions belaboured him with a slipper until he cried out—he was cured. In another instance a man remained dumb until he saw a child about to be run over in the street, when he shouted out to warn her. He also was able to speak from that moment. In yet another case a severe shock—the unexpected news of the death of a relative—restored speech.

THE STIMULUS OF PRAISE.
The face of the wounded man lights up at sight of M. Poincaré.

Even more remarkable were the cases of blindness. Men were met with who possessed good eyes and active brains, who could hear and speak well, but who could not see. Blindness was relative. Yet these men recovered sight in many cases instantly. In one instance a nurse went to the bedside of one of these people at 2 a.m., and said, "You can see now." The patient, who had been absolutely blind for a considerable period of time, replied, "I can, as well as ever I did in my life." He recovered his sight. Another man saw nothing until his

IN CHAMPAGNE.
On the way to hospital.

mother came to visit him in hospital. The sound of her voice "opened his eyes" as he himself expressed it.

The deaf, too, presented another astonishing aspect of the condition. They also recovered their lost sense often with extreme suddenness, and as the result of trifling events.

This failure of sense was not in any way connected with the sense organs. The dumb man, even when unable to produce any audible sound such as a cough or a laugh, had no lesion of his vocal cords or of his larynx, the blind man possessed normal eyes, the deaf man normal ears. Nor was the brain rendered insensible to sense impressions, for in some cases the blind man could see in the sense that he was aware of an outside world but could not interpret it. In the same way the deaf man was often aware that words were being spoken, though he could extract from these words no meaning.

Again, in all cases in which a man had lost the power of speech he could write down quite easily what he desired to say. One of these men wrote, "I hear and understand all you are talking about, and I know what I wish to reply, but I am unable to utter the words."

It was known that the special senses receive stimuli from the outside world which are read off by the brain, and either stored as memory images or else translated into action or both. It was known that certain areas of the surface of the brain (cortex) dominated certain functions, while other areas received and perhaps stored impressions from the senses. For example, cases were known in which a tumour or injury of the brain had deprived its victim of his knowledge of one language, but left him in possession of his knowledge of another—an Englishman was unable to speak French, but could still speak English. This strict localization of function and sense perception was well recognized, and from the recognition of it arose the idea that any particular activity, whether of sensation or of motion, calls into play a particular set of cortical brain cells.

The adult human brain is thus an instrument of great delicacy and complexity attuned to its work, able to show with speed certain responses, and to repeat these responses over and over again. Practice has made it perfect in certain clearly defined directions. Each man has built up his own brain aptitudes, has fashioned, that is to say, his own characteristics.

Now it was recognized that this delicate brain is an object of great solicitude on the part of Nature. The brain is the only organ

in the body which is completely surrounded by bone. It has a rich blood supply, and it is covered by a layer of fluid which serves to protect it from shock. But in addition to this it possesses means of its own which are capable of affording it protection against shock—internal means as against external means.

All the sense nerves of the body lead to the brain, which thus is affected at once by any stress or shock. A wound is reflected at once upon the brain by way of the sensory nerves leading from the wounded area to that organ. But the severity of the shock received varies greatly in different persons. Some men are able to "stand" a much more severe shock than are others. In the case of certain members of the community the mere sight of blood may be enough to produce a state of profound shock.

This knowledge was applied to the case of the victims of shell shock, and various deductions were drawn. The importance of a clear understanding of the condition was obvious, since only upon clear understanding can a rational treatment be built up. A great deal of attention was therefore given to what may be described as the theories of causation.

One theory tended to give prominence to molecular or chemical changes occurring in the brain itself. The tremendous force of the explosion, it was argued, was sufficient to disturb the normal chemical constitution of the blood, to liberate air from the blood, and so perhaps to set up so-called "air emboli." Again, it was noted that a shell which had exploded badly liberated carbon monoxide gas (CO.)—the gas so feared in pits. This gas exercises a profound toxic effect and may lead to instant death. It may, again, modify powerfully the vitality of the brain as a whole or in part, and so give rise to the typical symptoms of shell shock.

Another set of observers saw in the state of shell shock a state of suspended mental action. They pointed out that under the conscious mind lies the unconscious, and that the unconscious, or sub-conscious, mind is the repository of race instinct. The history of a man's ancestry is written upon his sub-conscious mind, and chief among the primitive or elemental emotions is fear. Thus when the conscious

UNDOING HIS WORK.
German helps to remove French wounded.

mind was in abeyance as the result of long continued illness or anxiety followed by shock fear tended to assert itself and to gain dominion over the whole being. It was fear which determined the blindness and deafness met with. As cure took place, the natural resistance of the individual was re-established.

Another view was that the shock of the shell released traits in the mind which had been buried and hidden during long periods, but which now again asserted themselves. Thus a case was cited in which a young man who had suffered from some religious trouble became much vexed by dreams after suffering from shell shock. The dreams indeed became a dominant in his life, and his health was seriously affected by them. Removal of the mental difficulty caused complete disappearance of the symptoms.

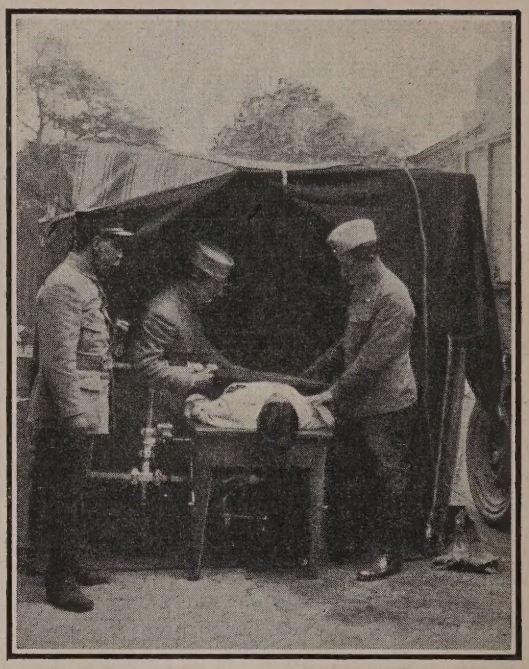
The types of the condition may thus conveniently be grouped under three headings:

(1) Those cases in which, as a result of shock, there was some molecular or chemical change in the brain itself.

(2) Those cases in which the condition was the end of a long process of weak health or weak nerves—"the last straw."

(3) Those cases in which some worry already present to the patient's mind had rendered him a suitable subject. After the condition had become developed, this worry would appear most probably in his dreams.

WEIGHING A CONVALESCENT.
Weights are taken daily.



X-RAYS ON THE FIELD.

This classification is necessary. In an article on a recent discussion on shell shock *The Lancet* called attention to some observations made by Dr. Henry Head, who has accomplished so much on behalf of the nerve-stricken soldier, and said that he "was not even content to allow the separate existence of the subject under discussion, holding it to be a heterogeneous collection of different nervous affections which have merely this much in common, that nervous control has at last given way. To him it would be just as reasonable to sweep up the various fruits which fall from the trees in a strong wind and then to discuss them without first stating that some fell from an apple and some from a pear tree."

The mechanism of production of the condition was also studied with great care both from the point of view of pathology and of psychology. In his Lettsonian Lectures Major Mott showed how sometimes small hæmorrhages in the brain were found; he also dealt with the aspect of causation by means of gas (CO.), and also as a result of intense atmospheric disturbance.

From the purely psychological point of view the power of dissociation shown by the brain seemed to be of great importance. Dissociation is a normal function, and is seen every day in

ordinary life. Thus a blow received during a fight is frequently not felt or not noticed. Again, in sudden shock the patient frequently is cut off from his surroundings, so that he seems to hear and see nothing, and later will confess that he felt himself become "almost blind and deaf."

The healthy soldier at the moment of acute tension should be to some extent "dissociated from his brain," if that term be allowed. His brain, in order to protect itself, should partially close the avenues of feeling, and should retire within itself, so that when the terrible effects of the shell fire are carried up the nerves to the brain they will find the way partially blocked, and will be less able to reach their destination in the cells of the brain surface.

The process of dissociation lasts but a short time, though its duration is determined to some extent by the circumstances of the case. It is essentially a protective process, but the word protective must be given a liberal interpretation, and must be made to include efforts at self-preservation.

Now fear is clearly the expression of a protective mechanism, just as anger is. Fear is the emotion which impels to safety by flight, anger that which impels to safety by attack. Both these emotions have at their command many functions of the body, and chief among the functions they control is dissociation. The power of the brain to dissociate is thus exercised when the man is angry or when he is afraid. Each man, however, possesses a control over his emotions—that is to say, he can prevent the automatic action of dissociation or, better, can limit and restrain it, thus remaining in touch with his surroundings and master of events. It is this controlling power which seems to be attacked by the shock of shells and warfare, just as it is this controlling power which is attacked in civil life by illness, exhaustion, exposure, and so on. The nervous man dissociates too rapidly and too completely; he is too continually in the protective state. And he may show this in the trenches either by some splendid deed of anger which wins him honour or by some deed of fear which brings shame. The exponents of this view emphasized, therefore, the fact already re-

BEHIND THE BATTLE-LINE IN FRANCE.

French soldiers having their wounds dressed before being taken to hospital.

ON THE WESTERN FRONT.

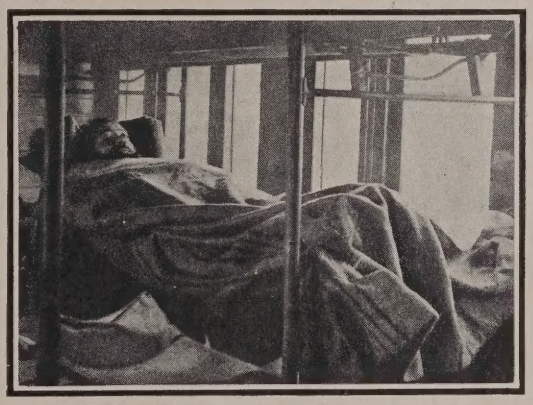
The driver of the ambulance was struck by a stray bullet; the horses bolted, but luckily towards the British trenches, where they were stopped.

ferred to—that the worst sufferers from shell shock were men with a previous history of nervous ill-health, or men who had been subjected to great stress and hardship, or, again, men who had not been disciplined and seasoned against the shocks of war. These men had either already exhausted their powers of control from over-use or they had not developed them. They were therefore less well equipped to withstand shocks than were their more healthy or better-trained comrades.

This view, it will be seen, offered a comprehensive explanation of many of the obscure phenomena of the condition of shell shock. It shed a new light upon the supreme importance of discipline and of seasoning of troops, and also of all the measures taken to ensure the well-being of the soldiers in the field. It gave new significance to Napoleon's famous dictum: That an army fights on its stomach.

But it did much more than this. It showed also that a normal process which gets out of hand may lead to a picture of disease, or, in other words, that disease may in some cases, at any rate, be an exaggeration of or an adding to the normal. Thus fear and anger are both normal processes, so also is the shutting off of the brain—" dissociation." The normal man is able to see without seeing and hear without hearing, and this ability is essential to his well-being for it enables attention to be directed in one way and cut off from other ways. But exaggeration of the protective power gives a violent reaction to small stimuli, which reaction may be so violent that seeing without seeing becomes " functional blindness," hearing without hearing becomes " functional deafness," and so on. In this way it comes about that shell-shock victims may suffer from paralysis which is merely functional, for in certain emotional states paralysis takes place and the animal falls—and may thus save its life by becoming inconspicuous—*e.g.*, deadly fear. This is an " idea paralysis " ; it is protection carried out of the normal into the region of the abnormal. Conversely it displays weakened or exhausted control. In exactly the same way the cases of mutism are to be explained. Loss of voice is a well-known accompaniment of some emotional states and may well be protective when a single sound would mean detection. In the victim of shell shock we see the condition carried to the last extreme. Shell shock, then, does not differ materially from the so-called " functional " nervous diseases of civil life.

The victim of shell shock was thus separated at once from the so-called malingerer on the one hand and the insane person on the other. Shell shock was revealed as a disease and, which is much more important—as in some respects a preventable disease. The army doctor found himself suddenly face to face with a new world—a world in which his duty was magnified sevenfold and in which his usefulness was given an almost unlimited scope. He had forced upon him the assurance that by every jot or tittle that the health or comfort or happiness of the men under his care was weakened, by so much was the chance of these men falling victims to the high explosive danger increased —and not to the high explosive danger alone, but to all those dangers incidental to warfare

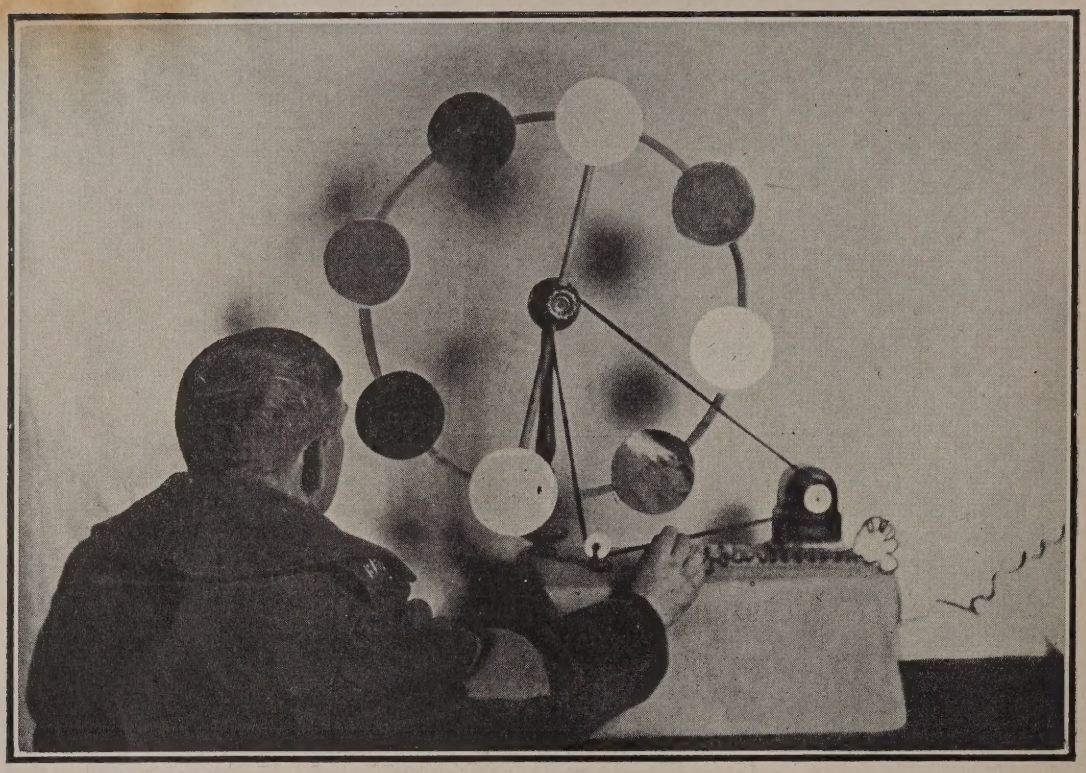


IN A HOSPITAL TRAIN.
The expression of relief on the patient's face is very evident.

which are summed up in the words " nervous breakdown."

The vast general importance of the conception need scarcely be insisted upon. A few of its applications must, however, be indicated. In the first place it was made quite evident that unseasoned troops must suffer greater injury from modern warfare than seasoned troops (because of undeveloped control), that they must be less effective in an important degree, and that they must be a greater burden upon the organization controlling and directing them.

In the second place it was made evident that the passage of unfit men into the ranks was not only a mistake from the social point of view, but also a danger from the point of view of the Army. The man of unfit type did not possess the power of control possessed by the fit man.



CURING SHELL SHOCK.

It is claimed that soldiers suffering from shell shock and nervous disorders can be cured by the use of this revolving wheel, which brings before the eye a constant succession of different colours. The patient can control its speed.

The danger that he would lose what little control he possessed could not be overlooked. And the infectious character of loss of control was a menace not to be disregarded.

Further, apparently insignificant details affecting the comfort and health of the troops assumed new importance. It became certain that even the smallest detail was so important as to merit careful attention. The Royal Army Medical Corps displayed a fine understanding of the situation, and set to work very early in the campaign to remove every cause of discomfort and to afford every legitimate manner of relief.

To begin with, the actual victims of shell shock were provided for. It had been established that these cases differed widely from cases of mental unsoundness, and it became abundantly clear that they must be treated upon special lines and not on any account allowed to fall under the stigma attaching to confinement in an asylum. The question was exceedingly urgent and called for settlement upon generous lines. It was taken up in a most public-spirited manner by Lord Knutsford.

Lord Knutsford's wide knowledge of hospital administration qualified him to speak with authority. He chose *The Times* as his medium, and on November 4, 1914, wrote as follows: "There are a number of our gallant soldiers for whom no proper provision is at present obtainable, but is sorely needed. They are men suffering from very severe mental and nervous shock due to exposure, excessive strain and tension. They can be cured if only they can receive proper attention. If not cured they will drift back to the world as miserable wrecks for the rest of their lives. A number of physicians have offered their services free to attend all these patients if a quiet home in London can be provided, and one in the country. The scheme has received the sanction and support of the War Office."

The appeal met with an immediate response, and Lord Knutsford soon had the £10,000 he asked for to start a hospital. He was fortunate in having a suitable house in Palace Green offered to him by the trustees of Lord Rendel's will, and he lost no time in putting his ideas into practice. Meantime the War Office made arrangements to open a hospital for men, and special facilities for the treatment of nerve shock cases were provided at the military hospitals throughout the country.

The Home Office, too, took the matter in

hand, and on April 23, 1915, Mr. Cecil Harmsworth, Assistant Home Secretary, introduced a Bill into the House of Commons in which it was provided that a man who in the service of his country suffered a nervous breakdown should receive treatment without being certified. The Act was to be cited as the Mental Treatment Act (1915).

The movement thus inaugurated was crowned with immediate success. In May, 1915, Lord Knutsford again wrote to *The Times*, stating that 100 officers had passed through the home at Palace Green and that, with but few exceptions, all had recovered from the effects of the shock of battle. The good work had been extended, thanks to the generosity of Mr. R. Leicester Harmsworth, M.P., who lent his house, Moray Lodge, Campden Hill, to provide a second home. The War Office, too, had broadened the basis of its work for the cases of shell shock and several neurological departments in London and the provinces had been organized.

Treatment was based upon the conception of the condition which has already been afforded. In the first place it was clear that the wounded mind must be rested, and must be secured against all manner of irritations. The idea was to allow the brain to regain its controlling power.

THE STAR & GARTER HOTEL, RICHMOND, WHICH WAS DEMOLISHED.

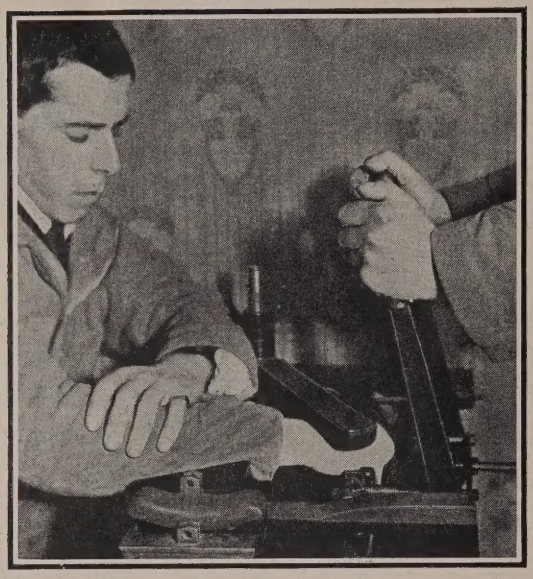
A hospital for soldiers disabled in the war is erected on the site.

The sick men were first of all placed in quiet rooms, darkened if necessary and excluded from noise and distraction. In this peaceful atmosphere the brain in many cases gradually sank into a condition of complete repose and the terrifying dreams and visions which haunted these men became to a great extent obliterated. Sleep returned. A certain relationship with the world was established, very feebly at first, later in a more secure fashion.

Meanwhile efforts of various kinds were

HIGH FREQUENCY CURRENT AT RENNES.

One of the ways in which "after treatment" is applied.



A STIFF WRIST.

initiated to assist this process of healing. In some instances hypnotism was employed to increase the state of repose and to suggest a more collected state of mind. In the hypnotic state many of the patients were able to express the ideas which troubled them and so in some cases to obtain relief from these ideas—though in the conscious state they had been unaware that these ideas were lodged in their minds.

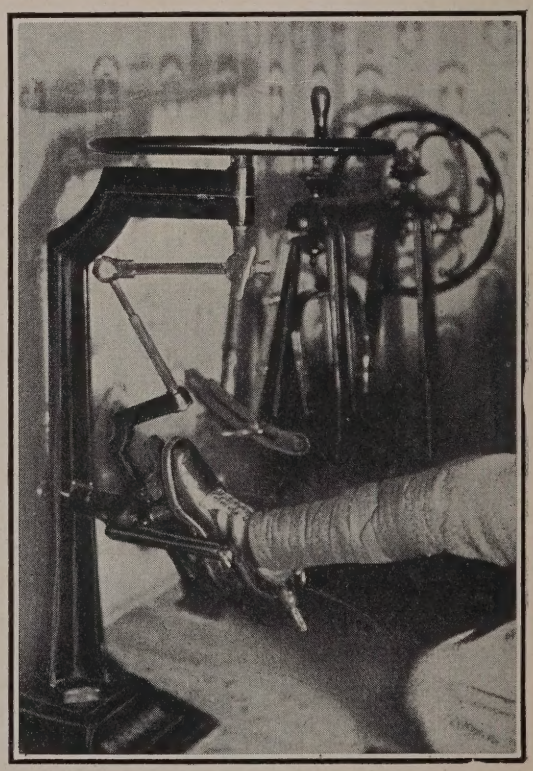
In other cases, however—and this illustrates the extreme difficulty of the subject—hypnosis produced rather ill effects ; it caused the patients to live over again their terrible experiences, and this was often an ordeal from which they shrank. One man found himself, while under hypnosis, back in France under shell fire, and on being awakened implored that the treatment be stopped. He had just seen his "pal's" head blown from his body by a shell.

Analysis of the wounded mind and so-called re-education was another method employed in respect of these cases. The object of this treatment was to reveal to the patient the process of mental action whereby events in his life had been woven into the fabric of the delusions and ideas which were tormenting him. For example, a man haunted by voices confessed that before the war he was bitterly jealous of, and unjust to, a friend and later suffered remorse on account of this. The voices were the externalization of his feelings of remorse. On this being explained to him he recovered. These and other lines of treatment accomplished a great deal, though cases were encountered which resisted treatment, and other cases occurred in which recovery took place suddenly as the result of some happy accident.

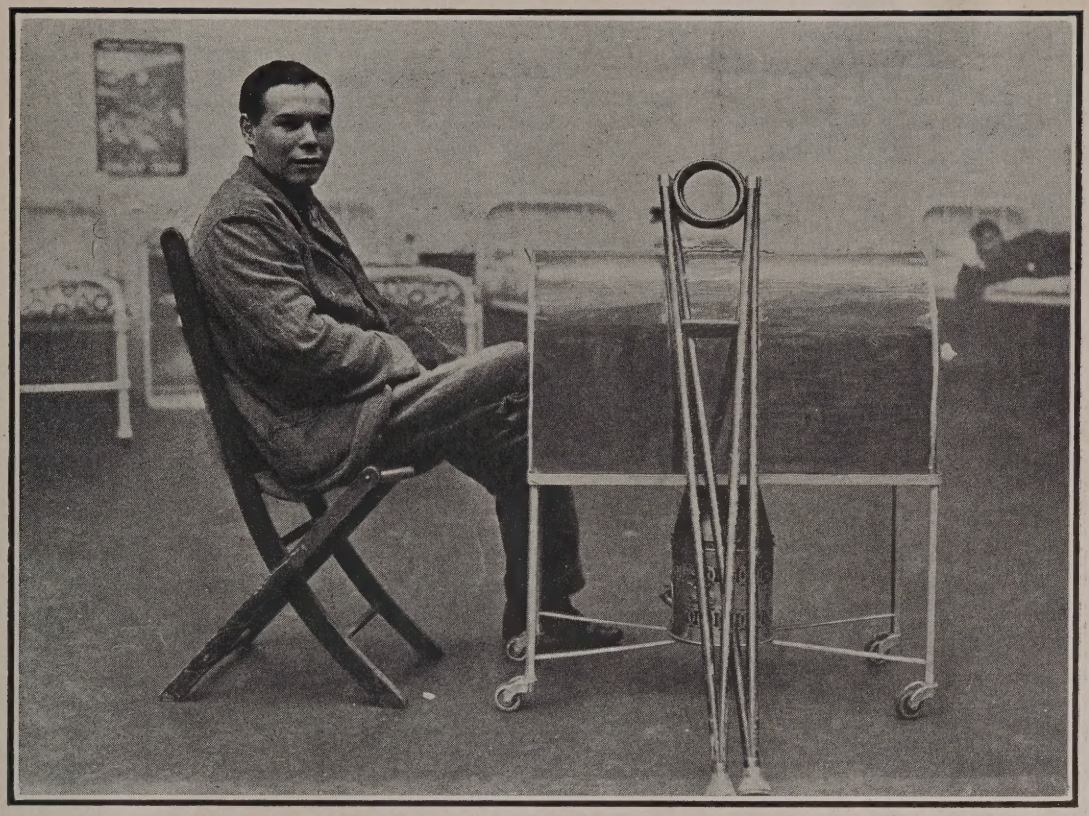
The second stage of treatment, as carried out by the majority of observers, was largely a stage of reintroduction to the affairs of life. The convalescent man was gradually brought back to the world, and by slow stages came to his place in the scheme of things. . . . The joy of these men when first it dawned upon them that they were on the way to recovery was often very touching, and in the sitting-room of the home in Palace Green many a moving scene was witnessed.

The after-history of the cases was on the whole good. Many returned to the front, many others were found to be able to undertake light duty at home. Only in a few cases was the breakdown permanent. These results more than recompensed the far-seeing men who had started the hospitals and justified to the full their view of the conditions.

Meanwhile the effects of the work on shell-shock were becoming apparent at the front. New ideas regarding the capacity of soldiers to stand fatigue and stress were gaining ground and the science of economy in human material was being studied.



APPARATUS FOR LOOSENING AN ANKLE JOINT.



ELECTRIC HEAT BATH.

It was becoming recognized, for example, that certain broad principles must be laid down with regard to the work of the fighting man inside of the zone of fire. A man, it was perceived, labours under limitations in respect of his power of standing the great strain of the trenches. At first his power was very limited indeed; later, as the result of habitude, his power was developed to a high pitch; later still it began to wane until, if relief were not forthcoming, a breakdown might be expected.

The coming of this knowledge—and knowledge came quickly in the days when the British line in France remained unsupported and unrelieved during long periods of intense fighting—wrought a revolution in military ideas. It was no longer possible or at least expedient to work with one army. A nation required relays of armies—day and night shifts, so to speak, after the fashion of industrial life. Moreover armies had to be "salted" carefully before they could be relied upon. Certain terrible experiences in the early days had taught commanders that to rush raw troops into the firing line was equivalent to sending them to destruction. These experiences had been brought about, it is true, by dire necessity, but repetition of them was to be avoided at all costs.

The military authorities soon learned that the actual numerical strength of an army in modern conditions is no criterion of its fighting strength at any given moment, and that in fact its fighting strength depends as much upon the factors of adequate preparation and adequate rest as upon the factor of numbers. This discovery was one of the circumstances which led to the demand for more men, and reinforced the other arguments for compulsory service.

This demand, if it be viewed dispassionately, was essentially a doctor's order. The medical men in charge of the troops demanded that the soldier should not be kept in the trenches more than a certain fixed period of time, and that he should be afforded an adequate period of rest immediately after he left the firing line. They based this demand on the knowledge that if it was not granted the whole nervous tone of the fighting force would be lowered and the force made more liable to nervous injury and also to the effects of shock and alarm.

As a result of these demands very strict measures were enforced. Young troops were seasoned gradually, and no troops were allowed to grow "trench stale." After a spell in the trenches the men were returned to rest camps,

TENDING FRENCH AND GERMAN WOUNDED IN A CHURCH.

which were started upon a great scale and which very soon proved their utility.

The rest camps were really great nerve recruiting establishments. Here every kind of effort was made to relieve nerve strain and to increase nerve strength. Every sort of irritation was removed. When the men arrived at the rest camp after a period in the trenches they were usually very weary. Trench life had robbed many of them of sleep, and in any case sleep was difficult in the conditions prevailing. The constant strain on attention had produced exhaustion both of brain and body; the wet and the mud had likewise exercised their effects. And the "minor horrors of war," the lice and other vermin which abounded in all the trenches, had added to the general discomfort.

Arrived at the rest camp, men gave themselves up at once to sleep. Some of them slept solidly for 12, 15, and 24 hours on end, in order "to make up for lost time." The relief experienced was remarkable and constituted one of the most striking vindications of the system of economy in human material which the war afforded.

When he woke up finally from his "sleep cure," the soldier went to the baths. These baths were among the show places of the front and deserved all the praise and credit bestowed upon them. An officer of the R.A.M.C. was in charge of each establishment, and the following letter from one of these baths officers reveals the nature of the work accomplished:

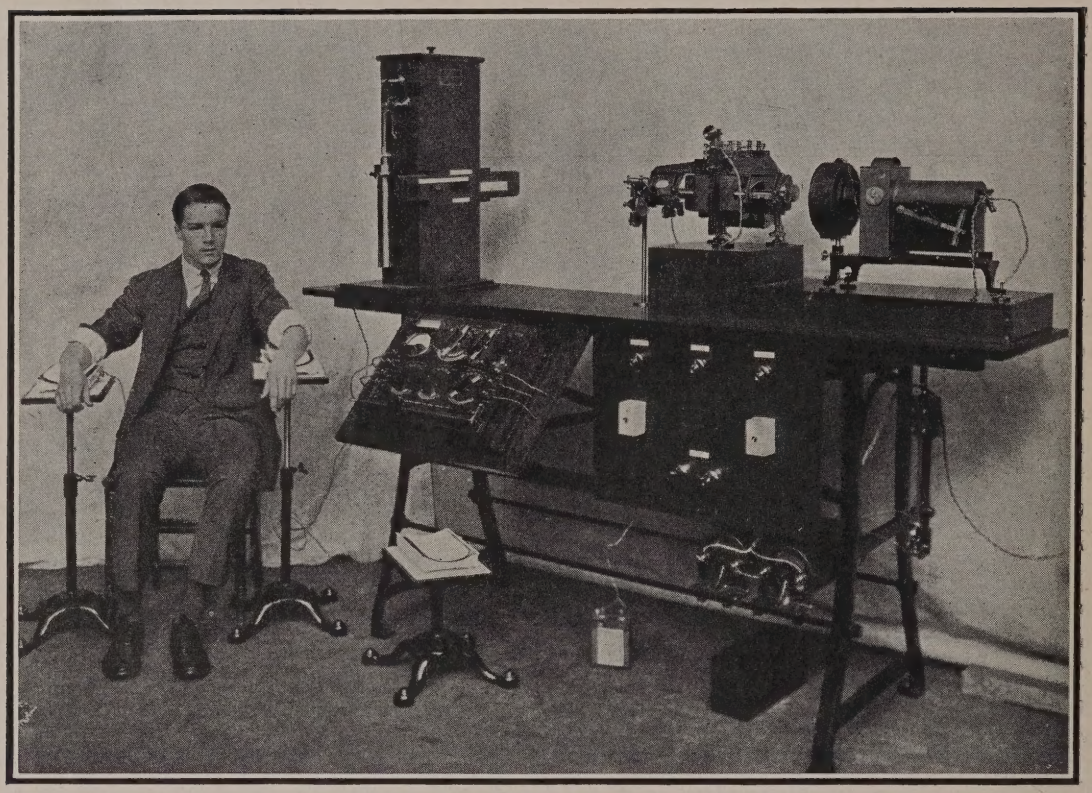
"Yesterday," he wrote, "I was given a new job; have been put, with my 36 bearers, in a brewery, and our job is this: when a brigade comes out of the trenches the men are very muddy and dirty. We have to see to the washing of the men; they are to come in to me by fifties. They go up to a big room on the second storey and undress, then they all go down to the basement where there are 50 tubs filled with hot water. They wash there and then go upstairs and dry themselves. Meanwhile their clothes have been taken and sorted out and the used up and torn destroyed and sent 200 yards down the road to another brewery, where are 24 washerwomen who wash and iron all the clothes. The men are supplied with all clean things—in the first case with new, but later on those sent to the washerwomen are ready for use, and so it goes on. We start work at 8 to-morrow morning and will go on until 5 o'clock without a break; 1,000 men a day we have got to do. As you can imagine, we are very busy. We have had to scrub the brewery out from top to bottom, wash out 50 tubs, and we are having 2,000 towels, 500 lb. of soap, 12 acetylene lamps, 500 pairs of pants, shirts, socks, etc., so you can see it is a big business." That letter was written in January, 1915. Within a month three breweries had been taken over and their barrels sawn to make tubs, and the movement spread rapidly.

The comfort of these baths was referred to again and again in letters from the front. After the cold and wet and mud of the trenches,

DRESSING THE WOUNDED IN A FRENCH CHURCH.

the warm water, the soap, and the clean, dry clothes gave a man a new outlook on life. Literally he was transformed: the hopeless weariness which had given to his face the dull, expressionless look so characteristic of the overwrought soldier, passed away. He became "twice the man" in the space of a few hours.

The clean clothes, too, meant relief from the horrible vermin which tormented the men in the trenches. It was noticed that long exposure to the attack of these vermin made a man nervous and irritable. This again lowered his resistance and rendered him more likely to break down. Fumigation of clothing and frequent changes of clothing were therefore medical as well as social measures. They were



THE COMPLETE ELECTRO CARDIOGRAPH OUTFIT.
By means of this instrument the electric waves set up by the heart beats are photographed.

a part of the great campaign of prevention which in various ways was waged continuously by the Royal Army Medical Corps on behalf of the fighting men. And, indeed, in this campaign may also be included the recreations which were provided at the rest stations—the cinematograph entertainments, the concert parties, and the various other forms of distraction.

There remained, however, a number of purely medical problems which called urgently for solution. Among these was the trouble known as "trench-feet." As a result of this trouble a great number of men suffered, during the early days, a vast amount of pain and inconvenience; good men, otherwise perfectly fit, were lost to the fighting forces, and men of all types were pulled down in health and rendered more liable to general breakdown.

Trench-foot made its first appearance during the winter of 1914–1915 when the sodden fields of Flanders became a quagmire and trenches filled with water. Men during this period had often to stand during days and nights knee-deep in water. There was no proper protection against the water which was, of course, cold.

The condition varied in different individuals but was generally characterized by a redness or blueness of the feet, by a state of the skin which resembled chilblains and, in its more severe forms, by gangrene and death of the tissues. It was thus a very severe condition—from the point of view of the administration it was as bad as any epidemic, for it laid useful men low and burdened the medical service with a huge number of incapables who had to be transported to England and then nursed back to health. Recovery was notoriously a slow business.

The first step was clearly to determine the nature of the affliction. Several investigators took the matter in hand and began to experiment, and notable among these was Professor Delepine. Professor Delepine carried out a number of investigations with a view to determining the effects of water upon the skin, (1) at ordinary temperatures, and (2) at low temperatures. It was found that neither wet of itself nor yet cold of itself was capable of producing the condition of trench-foot, but that the condition supervened rapidly when the two factors came into play at the same time, for example by evaporation. It became clear, therefore, that if steps were taken to protect the men from wet the effects of cold could to a great extent be discounted. Professor Delepine

suggested the use of a light material like oiled-skin worn in the form of extensions of the boots and coming well up the thighs so that no wet should be allowed to reach the skin.

Other investigators arrived at conclusions which corresponded more or less closely with those reached by Professor Delepine. Recommendations that the feet should be covered with fat or oil were made by some and were carried out with good results in various quarters. The use of fat was, of course, only another method of excluding moisture from the skin and so eliminating one of the essential factors in the production of the condition, or it was another method of applying a non-conductor of heat and so preventing heat loss and evaporation.

Finally, a definite system of foot care was established. The men going into the trenches had their feet examined to ensure that the skin was healthy and free from cracks and abrasions. They were then provided with good thick socks to be put on after the feet had been greased. Over the socks carefully dried gum boots, or waders, coming well up the leg, were pulled on. The use of constricting leg-wear, *e.g.* tight puttees, was abandoned. Puttees were especially bad because of the very large surface afforded by them for evaporation.

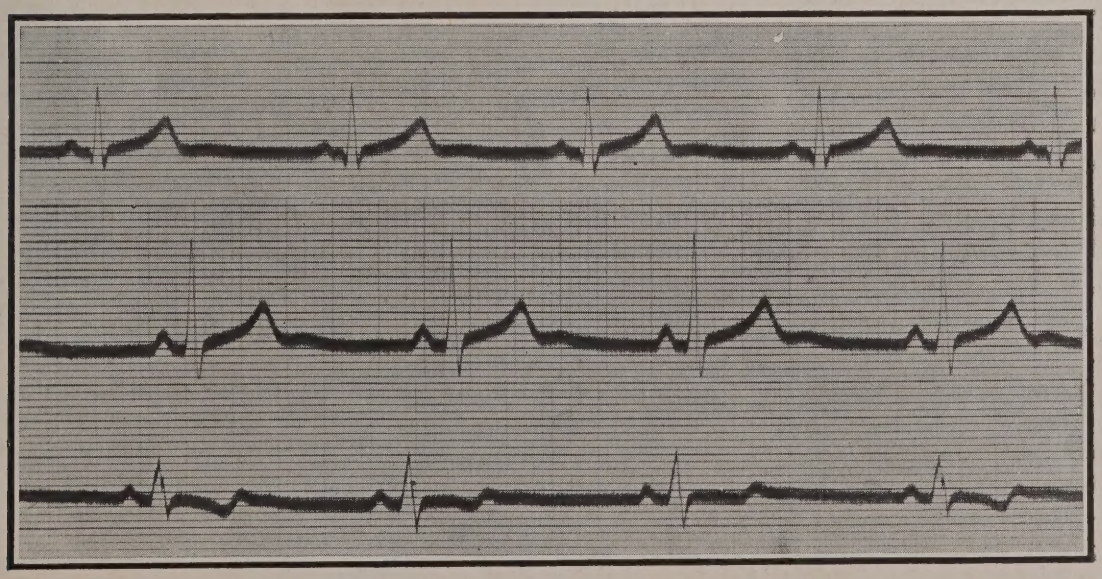
It speedily became apparent that these precautions were sufficient to banish trench-foot altogether. The condition, indeed, began to disappear as soon as the precautions were instituted and medical men were told off to inspect the boots of the men coming from the trenches and to report on their condition, and the utmost care was taken to ensure that no leaky boot should pass to a soldier about to begin his trench work.

Trench-foot, as the result of these efforts, became a "crime." That is to say, that if there was an outbreak of the condition some one was held responsible for it. The outbreak could, in almost every case, be traced to some negligence. Either a man had put on his boots while they were wet inside, or he had failed to take the necessary precautions to prevent water entering his boots, or the officials in charge had allowed boots with a leak in them to pass muster.

The conquest of trench-foot was a very important matter and reflected great credit upon the men who carried it through. A considerable portion of the scientific work was carried out at the instance of the Medical Research Committee of the National Insurance Act, which thus added another item to the long list of benefits conferred by it upon the Army during the war.

Careful attention to the feet in the rest camps was of course an important feature of this aspect of the work for the soldiers' well-being. Regular inspections were carried out, and great care was taken to detect cracks in the skin and to treat them at once when detected. The result was a raising of the general comfort level both in and outside of the trenches and so a general raising of the spirit of the men—an achievement the importance of which cannot be exaggerated.

The period of rest, then, was no mere time of



ELECTRO CARDIOGRAM OF A NORMAL HEART.

GERMAN RED CROSS TRAIN: WOUNDED WAITING THEIR TURNS.
The dull apathetic expressions of the men should be noted.

idleness. It was a vital necessity to the well-being of the forces, a true recuperation period, yielding as its fruits increased efficiency, augmented fighting value and a greater power of resistance both to disease and to the effects of modern warfare—shell-shock, neurasthenia and depression. It owed its origin in no small measure to the intelligence of the administrators of the Army Medical Service, who were quick to profit by experience and to translate the mistakes and ignorance of the past into the triumphs of the future.

While these works, dictated by a clear understanding of the mental effect of war, were in progress, another condition to which the soldier seemed very liable was forcing itself upon attention. This condition was known as the "soldier's heart," or the "irritable heart of soldiers," because it had been met with in many other wars and seemed in some way to be connected with warfare.

There were many points of similarity between the soldier's heart and the state of nerve weariness produced by high explosive shells. On the other hand, various differences were soon recognized. For one thing, the soldier's heart was not a new problem in the sense in which shell shock was a new problem. High explosive shells had produced an "epidemic" of the latter condition, they had not exercised a like effect upon the former. Whereas shell shock was relatively infrequent in other campaigns, soldier's heart was relatively frequent, and it was not clear that the introduction of massed artillery had produced any very great effect upon the incidence of the disease.

"Soldier's heart" therefore fell into a category by itself, and the study of it was entrusted to heart as opposed to nerve specialists. These heart specialists very soon discovered that a very obscure type of disease awaited their unravelling. And a knowledge of the history of the condition served to confirm that first impression.

The history of "soldier's heart" is the history of an unsolved riddle. The story begins in the days of the Crimean War, when a number of soldiers were sent back to England because they had developed a form of palpitation of the heart which proved persistent. Few of these men recovered. The second chapter of the story concerns the American Civil War, in the medical history of which "soldier's heart" seems to have played an important part. So frequent was the trouble, indeed, in this war that special investigations were instituted and a special hospital opened in Philadelphia. This hospital was presided over by Da Costa, and that eminent doctor made a prolonged and very careful study of the disease and gave to it the name which it now bears.

Da Costa's monograph on the subject presented a picture which was as true in respect of our soldiers as it was in respect of the American soldiers of his time.

"A man," he wrote, "three months or so on active service was seized with diarrhœa, annoying yet not severe. Soon rejoined, and then noticed that he could not bear exertion as well

as formerly. Out of breath and unable to keep up with his comrades; dizziness and palpitation. Accoutrements oppressed him, yet otherwise he seemed well and healthy. Sought advice; was sent to hospital, where his persistent quick pulse confirmed his story. Digestive disturbances if present passed away, but the irritable condition of the heart remained, and only very slowly did this get normal or it failed to do so."

The British Government of the time gave some consideration to the question and appointed a Commission in 1864 to investigate the whole problem of heart disease in the Army. This Commission sat during four years and issued many reports. In one of their reports the Commissioners referred specifically to the "soldier's heart" and described it as "an extreme excitability of the heart, combined with some, but not great, enlargement. During rest a heart of this sort beats easily, but on the least exertion its action becomes irregular and the man becomes breathless."

The Committee ascribed this trouble to the wearing of tight accoutrements, and on their recommendation the tight accoutrements were abandoned. This, however, by no means ended the difficulty, and the cases of soldier's heart continued to arise whenever any military operations took place. Further study was, therefore, given to the matter, and in 1876 it was suggested that the condition arose as the result of what was known as "setting-up drill"—i.e., the drill given to recruits with a view to making smart men of them.

This suggestion was supported by much evidence and resulted in the abolition of setting-up drill. But no change took place so far as the soldier's heart was concerned.

The matter received little further attention until the present war, when it immediately assumed great importance, and it was realized that steps must be taken to investigate it over again. It was clear that whatever might be the cause the result was a heavy loss both to the Army and to the Public purse, for the victims of the disease became useless so far as fighting was concerned, and they remained a burden on the State in the military hospitals. The men were not actually very ill: indeed, in a broad sense they enjoyed fairly good health, but they were unable to perform any work. The mild character of their complaint encouraged the hope that they would be restored, and this tended to keep them in the Army. But this hope was seldom realized.

Acting under instructions from the War Office, the Medical Research Committee took up the question and appointed Sir James Mackenzie to open an investigation into it. This investigation was planned upon the most comprehensive lines and embraced observations made at

HEAT BATHS.
Contrast the expressions with those in the picture opposite.

A FIRST-AID DRESSING STATION UNDER FIRE.

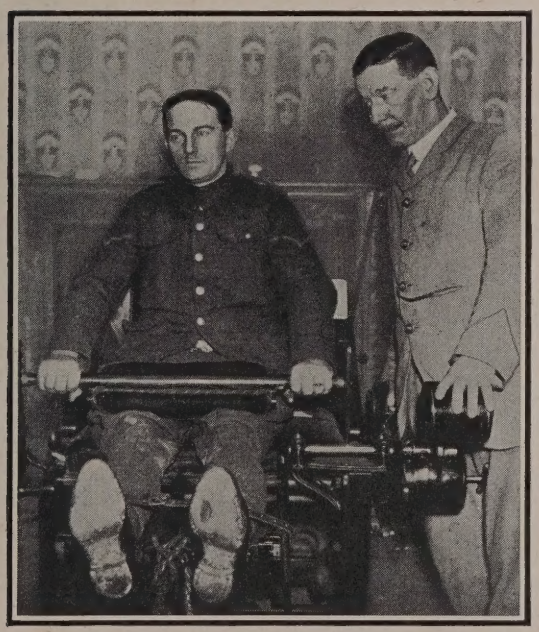
the front, in course of transit from the front, and in the hospitals at the base and at home.

Before long it was determined that whatever else the "soldier's heart" might be, it was not heart disease as that term is usually understood.

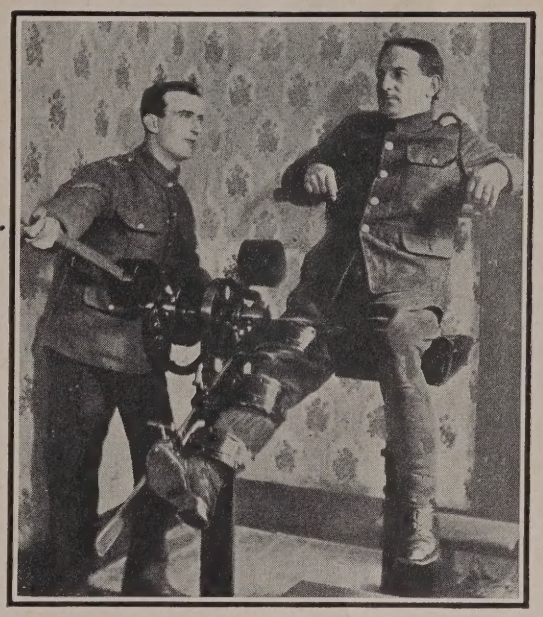
The scientific work accomplished within recent years on the subject of the heart in health and disease forms one of the most brilliant chapters in contemporary medicine. From a state of obscurity comparable to mediæval darkness heart medicine had passed almost at a bound to a state of great enlightenment. Thanks especially to the pioneer work of Sir James Mackenzie heart diseases had been classified and rendered easily identifiable and appropriate treatments in many instances secured. This work had been carried on latterly at the London Hospital, where a special department had been instituted and special instruments installed, and already it was attracting world-wide attention and interest.

The outcome of this work was, as has been stated, a greatly extended knowledge. In the light of that knowledge it was possible to draw a distinction between "soldier's heart" and other heart conditions and to relegate the affection to a class by itself.

But the puzzle was not the less a puzzle because its limits had been defined, and it soon became evident that if it was to be solved special lines of investigation would be required. It was at this point that Sir Alfred Keogh, Director-General of Army Medical Services,



MANIPULATING THE THIGH AND KNEES.



MANIPULATING THE LEG.

displayed his administrative ability and scientific acumen by deciding, on the advice of Sir James Mackenzie, that a special hospital was necessary for the investigation and treatment of cases of soldier's heart.

The idea was a good one, for it brought into close cooperation the work of the scientific laboratory and the no less scientific work of the physician. The physician was to study the malady in mass and he was to have at his disposal the very best and most recent methods which science had produced. Nothing was to be denied him which might make for the easy solution of the many difficulties besetting his way.

This idea necessitated for its proper translation into action the cooperation of the most mature clinical and scientific minds, and the Medical Department of the War Office appointed as consulting physicians men of such great reputation as Sir Clifford Allbutt, Sir James Mackenzie and Sir William Osler. The staff of the hospital included also Dr. Lewis, consulting cardiologist to University College Hospital; Major Meakins, of Montreal; and Captain Parkinson, of the Cardiological Department of the London Hospital.

The selection of a suitable place for the work was somewhat difficult, but finally the hospital at Mount Vernon, Hampstead, known as the Hampstead Military Hospital, was chosen. It was soon evident that the choice was a good one, for the situation on the hill-top proved ideal and exercised a beneficial effect upon the spirits

1 2 3

THE HAVOC

A Study in expressions: (1) After Verdun (2, 5) Wounded

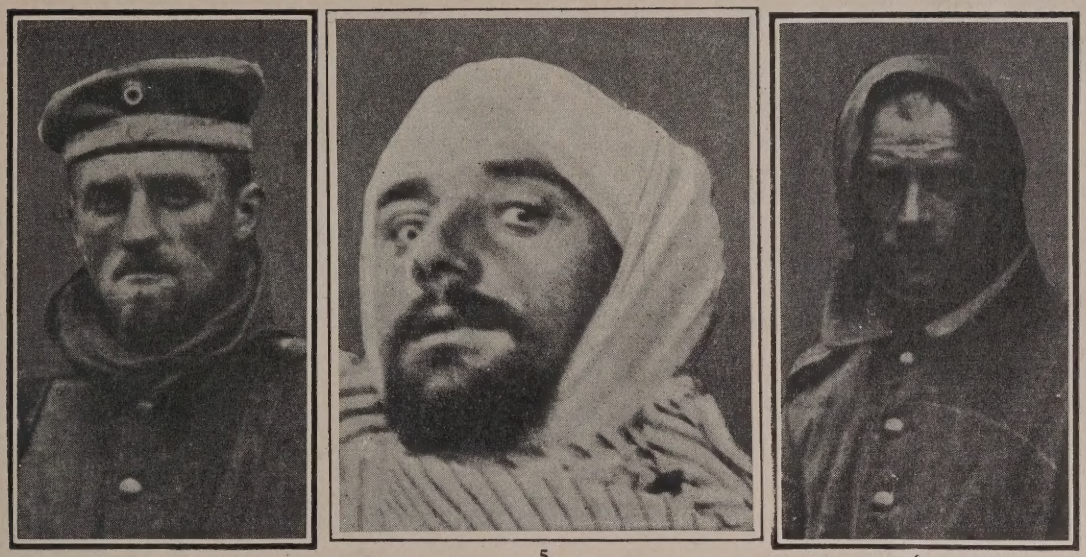
of the patients. Colonel More Reid, who had been officer in command of the hospital before its conversion, was appointed to command the new hospital.

The work had not been in progress for long before much new light had been obtained. The idea, for example, that a cheerful atmosphere and congenial surroundings would exercise a very beneficial effect upon these soldiers was justified by experience, and it was found that, as already anticipated, these were not instances of organic heart disease in the usual sense of the term. Treatment by a system of modified exercises and games such as skittles, badminton and bowls (kindly presented by the British Red Cross Society) was instituted, and laboratories were fitted up for the investigation of the cases by means of the electro-cardiograph—a very delicate instrument which enables a photographic record of the nervous impulses set up by the heart's action to be made—the ortho-diegraph —which gives an exact record of the size of the heart—the X-rays and the ordinary methods of bacteriology.

This great work began therefore under the best possible auspices and little doubt was felt that it would be productive of important results both for the army and, at a later period, for the public in general. If any proof were required that in Sir Alfred Keogh the people of England possessed an administrator of imagination and ability this heart hospital furnished that proof. It was an answer to many an ill-informed criticism and it showed that in spite of all the many matters pressing upon his attention the Director-General had time to consider the well-being of those unfortunate men who had in a very literal sense "fallen by the way."

Soldier's heart, then, was an effect of war upon the man himself; it was a mental effect as well as a physical one, for while the heart was involved in the condition, the "spirits" also were involved and that, perhaps, to a greater degree. The soldier afflicted by this malady was, so to speak, less of a man than his healthy comrades; he lived upon the edge of nervous breakdown and he felt, in his own expressive mood, "rotten." Whatever the cause of his disability might be, one thing was clear—the stress and strain of war, the cold and damp of the trenches, and the shock of the high explosives, played a part; they were contributory causes. And the stronger the man was and the better conditioned the less likely was he to suffer from this trouble.

In the course of a paper delivered before the Royal Society of Medicine in February, 1916, Sir James Mackenzie said, regarding these cases: "We must understand the life in the trenches. The story of some of these soldiers is illuminating. One in December, 1914, suffered from appendicitis and was operated on. He returned to duty three months after, and in June went to the Front. Immediately on arrival he went into the trenches and was there a fortnight. Every night was spent in repairing the damaged parapets. They were constantly being shelled. He never slept at night and occasionally got a few hours' sleep in the day—often being 24 hours without sleep. One day a shell exploded in the trench, knocking him over



4 5 6

OF WAR.

(3) Gassed (4, 6) Effect of high explosive shell fire.

and rendering him partly unconscious. On regaining consciousness he stuck to his work for 24 hours, but had to give in, feeling weak and ill with pain over the region of the heart. . . . So great is the mental strain and bodily exertion with sleepless days and nights, while the trenches are frequently bombarded, that one might be disposed to consider that these two factors would be sufficient to account for all the symptoms. But we find identical symptoms present in many who have never been to the front, and who have had no excessive bodily or mental strain, but who have suffered from some febrile infection. . . . The principles of treatment should be devoted to increasing the health of the body and to bracing up the whole man, bodily and mentally. . . . The men often feel miserable, so that there is a mental side to the case which is aggravated by the supposition that there is something wrong with the heart."

But there was another type of injury inflicted by the enemy against which natural resistance availed less than against high explosive shells—though, as will be seen, natural resistance was a factor of great importance. This was not in the strict sense a nerve injury, yet its effects upon the mind of the soldier were great indeed and fully entitle it to be included in a survey of the general impress of modern warfare upon the human material of war.

This injury was what has been generally termed "gas poisoning" and was the result of inhalation of the poison gas liberated from the German trenches, and also of the gas liberated by specially constructed shells.

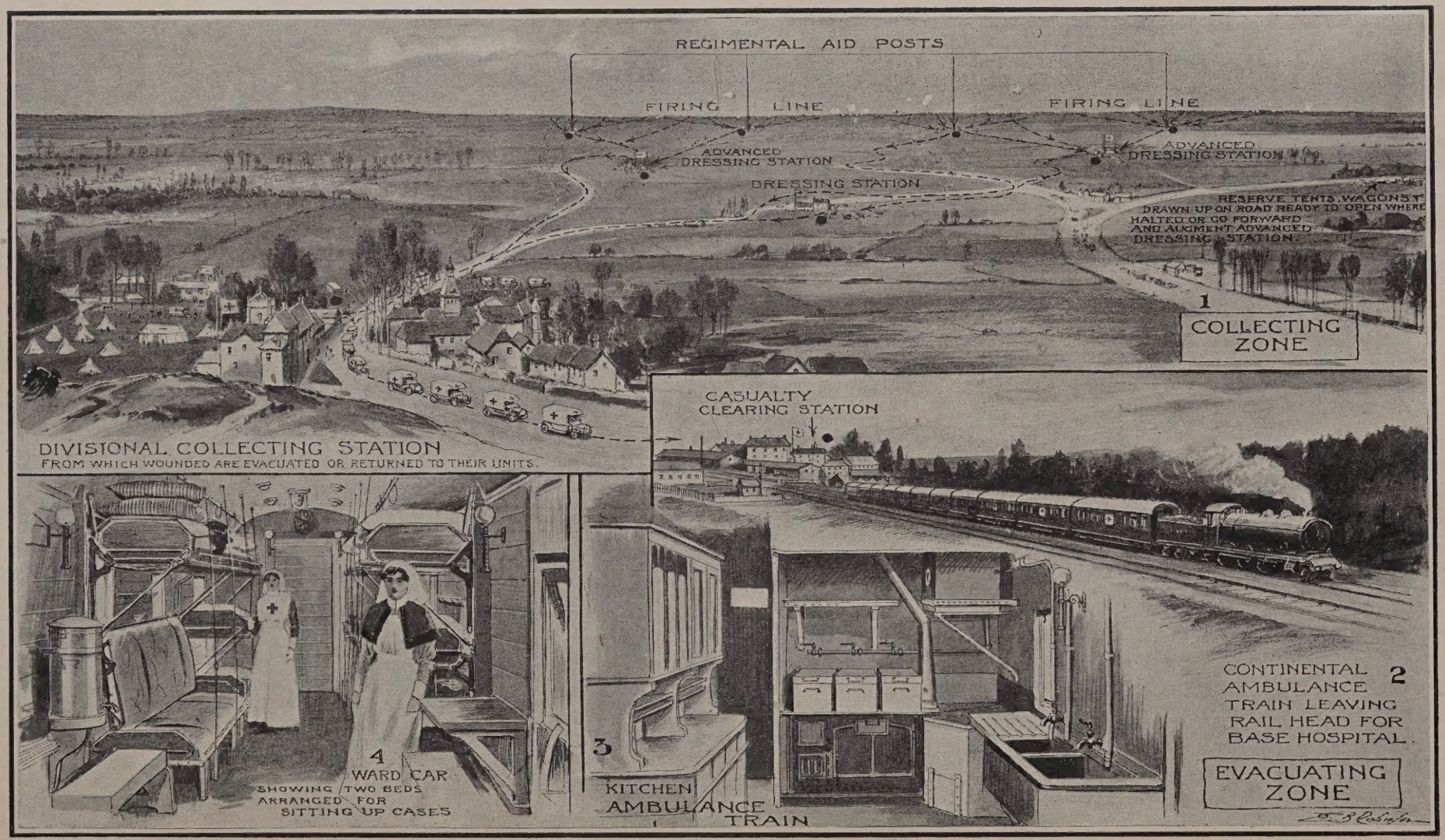
In a previous chapter of this history * the matter was dealt with from the point of view of the doctor. It was indicated that the gas in use in the earlier days of the war contained a large quantity of chlorine, and that steps had been taken to combat its effects by means of the use of respirators containing substances which combine with chlorine and render it inert.

After the comparative failure which attended the use of their horrible weapon the Germans began to employ a variety of different kinds of gas, and especially gases of an acutely irritating kind (lachrymatory shells) which cause a flow of lymph in the air passages and so literally drown the victim. The constitution of these gases was probably similar to the constitution of the earlier forms, but the effects produced seemed to differ at different times and in different areas.

Now, in order to appreciate the value of gas as a weapon, and also in order to appreciate the effect of it upon the soldier, it is necessary to adopt the soldier's point of view. One must attempt to see the gas cloud not as it is seen in the laboratory, but as it is seen in the trench when the wind is favourable and the enemy active and threatening.

In the first place it is necessary to realize that the soldier has probably already seen the effect of the gas cloud, and therefore there is present to his mind the picture of the sufferings which gas is capable of producing. Upon these

* Vol. VI., p. 78.


REGIMENTAL AID POSTS
FIRING LINE
FIRING LINE
ADVANCED DRESSING STATION
ADVANCED DRESSING STATION
DRESSING STATION
RESERVE TENTS, WAGONS &c DRAWN UP ON ROAD READY TO OPEN WHERE HALTED OR GO FORWARD AND AUGMENT ADVANCED DRESSING STATION
1
COLLECTING ZONE
DIVISIONAL COLLECTING STATION
FROM WHICH WOUNDED ARE EVACUATED OR RETURNED TO THEIR UNITS.
CASUALTY CLEARING STATION
CONTINENTAL AMBULANCE TRAIN LEAVING RAIL HEAD FOR BASE HOSPITAL.
2
EVACUATING ZONE
3
KITCHEN AMBULANCE TRAIN
4
WARD CAR
SHOWING TWO BEDS ARRANGED FOR SITTING UP CASES

FROM BATTLEFIELD TO BASE HOSPITAL.

sufferings it is unnecessary to dilate ; they have been fully described in previous chapters. But the mental effect must be realized. It was an effect of great importance and only steady nerves were capable of withstanding it. The tension experienced while awaiting the gas cloud was extreme, and this even when the men were provided with efficient respirators and were thus, relatively, immune. Here, as in the case of the high-explosive shells, the men with steady nerves were in the best position and were more likely to escape than those whose nerves had been weakened, or whose discipline was lax.

As the cloud approached the presence of the gas became appreciable in the air. Professor Hill in a lecture before the Medical Society of London pointed out that " the effect of 1 in 10,000 chlorine is such that no man would endure breathing it who could escape from its influence. The eyes and the mucous membrane of the respiratory tract are intensely irritated and a watery exudation takes place—the inevitable effort which the living tissues make to dilute so irritant a poison." It was at this point that men unaccustomed to the gas, or men very much oppressed by it, were apt to act in a manner calculated to fulfil the hopes of the enemy. Thus in one or two instances it was observed that men, feeling the difficulty of breathing, tore off their respirators in spite of warnings, and so became asphyxiated. Other men unable to stand the strain threw themselves down and thus plunged more deeply into the heavy fumes. In other cases regiments maintained their coolness even in face of the horror, held their ground, and, thanks to their respirators and the fact that the gas is more dilute the higher up one goes, were able to endure the passage of the cloud and to meet the enemy when he charged behind it.

It is clear, then, that the mental and moral factor can be no more eliminated from consideration of this weapon than it can from consideration of the effects of high explosives, or from the causation of soldier's heart. This was obvious at once to those in charge of the troops, and the splendid stand of the Canadians at Ypres during the first great poison gas attack of April 22, 1915, will remain as a testimony to the nervous equipoise and stern discipline of that gallant contingent.

What was equally obvious was that the use of efficient respirators—*i.e.*, respirators which the men had proved to be efficient—must have a big moral value in addition to a protective value. The search for good respirators meant really the search for suitable substances to put in the respirators, for if the gas could be combined at once with some chemical which would render it inert the danger would be at an end.

The medical authorities displayed great energy in grappling with the problem and they

IN THE VOSGES
A mountain dressing station.

called very eminent men to their help. The result of the work of Haldane and Barcroft and other eminent physiologists was a great and immediate improvement in the situation and a restoration of confidence which was gratifying. The men felt that they could rely upon their respirators and this knowledge steadied them. They were thus less liable to injury from the gas, for their natural power of resistance, or control, was more fully developed and was not so apt to be " stampeded."

Moreover, the soldier soon learned that his

BREATHING OXYGEN.
A method of treating the gassed.

doctors were grappling with the problem of how to relieve those who, in spite of all precautions, had been "gassed," and this again gave him confidence. (One of the most remarkable features of war is the good effect upon the *morale* of troops of an efficient medical service. The knowledge that he has good doctors behind him cheers a man almost as much as the knowledge that his guns are efficient or that there are plenty of men in reserve behind him.) The treatment of gassed patients was an exceedingly difficult problem, and at first puzzled sorely those entrusted with the solution of it. Gradually, however, methods were evolved and existing methods improved upon. In the first place the necessity of getting rid of the outpouring of fluid from the tubes was recognized so that the patient might be saved from choking—or rather from drowning.

One of the means adopted to this end was artificial respiration—*i.e.*, the means employed in cases of drowning. Forms of apparatus were constructed to facilitate this work and to keep up the artificial respiration during periods of time. Oxygen was also given in continuous stream, and methods were devised of combining oxygen inhalation and artificial respiration. Experiments on animals had shown that compressed air relieved the breathlessness just as oxygen did. As the result of these experiments it was suggested that so-called medical air-locks might be constructed after the fashion of those used in compressed air tunnel work, and patients placed in them and compressed to two atmospheres. At the end of the period slow decompression would be carried out. The difficulty here, however, was the

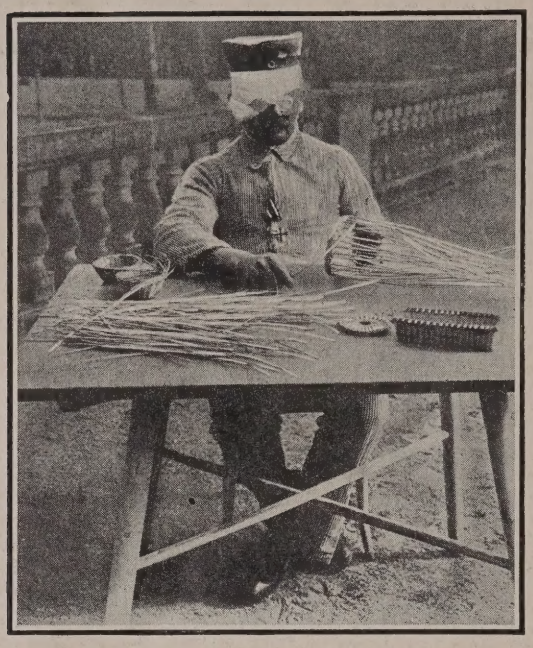
BEFORE A GAS ATTACK.
The men carry their respirators in tin cases to keep them moist.

BRITISH OFFICERS TESTING RESPIRATORS.
Small Picture: A type of respirator.

weight of the apparatus. Nevertheless the principle was applied in other ways with satisfactory results.

While, therefore, it could not be said that poison gas had been robbed of its terrors, much had been done to lessen these terrors and to minimize the moral effect of the gas upon the minds of the troops. The outcome of this work was a conviction, which hardened with time, that in modern warfare the fit man and the disciplined man are at a great initial advantage, and secondly that this advantage may be improved or depreciated in value by the medical staff. With the medical staff, indeed, were all the issues, for the minds of the fighting men, as well as the bodies of the fighting men, were in their care, and the minds, as was shown again and again, were more important, in the last issue, than the bodies. The medical staff could not fight battles, but they could assure victory beforehand by keeping the fighting men in fighting trim. They could minimize the effects of high explosives by insisting upon proper rest periods being afforded, and by demanding a high standard of comfort in the rest camps, adequate bathing arrangements, recreations, foot care, vermin destruction; they could lessen the chances of soldier's heart making its appearance by the same means, by close attention to the personal hygiene of the men, more especially as regards the care of the teeth, and by strict measures to prevent the outbreak of infection; finally they could "draw the sting" of the poison gas by adequate protective measures in the field, adequate recreative measures behind it, and adequate hospital measures at the base.

It is necessary to insist upon this view of the subject, because by the adoption of this view



A BLINDED GERMAN SOLDIER BASKET-MAKING.

a revolution was wrought in the whole science of war. Like most revolutions this one had been anticipated to some extent by the great leaders of old time and notably by Napoleon. Napoleon was perhaps the greatest mind doctor ever given to an army. His knowledge of the value of the mental factor was astonishing and was scarcely ever at fault. In every bulletin which he issued to his troops this knowledge was revealed. His prescription for defeat was victory, the prospect of victory or the memory of it. By this alchemy drooping spirits were revived, sick men literally made whole, the effects of enemy attacks and surprises negatived and annulled. The confidence of the soldier was precious to him as the assurance of success.

It is not perhaps possible to estimate at this time how much or how little use our generals made of the great force of the mind. But one thing is certain: Had not our Medical Corps been directed by a very able man and a man of vivid imagination the essential revolution would have been postponed, perhaps until too late. Sir Alfred Keogh brought much more to his work than ripe knowledge and experience; an Irishman, he brought the imagination and the inspiration of his race. He saw his task clear, and he saw it whole; he knew the vast importance of it, and realized that in this war at any rate the doctor held in his two hands the issues of defeat or victory. It was the doctor who should make the man.

A medical service was evolved which won the confidence of the common soldier and which secured the best use of the material available. Ignorant critics poured ridicule upon the "waste of doctors" occasioned by the use of doctors to examine the boots of men coming out of the trenches. The doctors themselves, who had seen cases of trench foot, knew better; other critics sneered at the attachment of medical men "to bathing establishments"; their lack of imagination made no difference to those in authority. The great plan was adhered to. The well-being of the soldier was the unceasing care of his doctor. And the doctor's reward was to be found in the issue of almost every combat.

It would not be possible to bring this chapter to a close without a reference, however brief, to a special aspect of the work of helping the soldier back to that normal state of mind and body which is called health—the after-treatment of injuries about the face and of stiff joints. This work, indeed, though it belongs in a sense to the surgery of the war, possesses a psychological importance which is perhaps its chief claim to consideration. A man disfigured by a wound of the face can live and can work; his working capacity is not diminished. On the other hand, life for him is robbed of the greater part of its joy. He may be an object of pity, he is also, and he knows it, an object of fear. Men honour him, but they shun his company because his sorrow is too terrible to be viewed without pain. Thus he is driven in upon himself and cut off from his fellows. His world becomes a place of gloom and his mind a harbour for bitter and sorrowful thoughts. And in a lesser degree the same is true of the man crippled and deformed by wounds and by the effects of wounds and of sickness in body or limbs.

The problem of the treatment of these cases presented itself very early in the war, and in regard to the injuries of the face and jaws the credit for the earliest solution of it belongs to the American surgeons and dentists who so generously gave their services in Paris during the period of the Marne and the Aisne, and to Claude Martin, of Lyons, who was the first man to devise a scientific method of dealing with the cases.

The method of treatment adopted aimed first at preventing deformity by early and efficient measures, and secondly at curing those de-

formities which had already occurred. As most of the face wounds involved jaw injuries, dentistry was essential to success—not the ordinary dentistry of civil life, but that highly specialized kind which has raised the schools of France and America to a pinnacle of fame. The principles were these: complete reduction of displacement and maintenance of the remaining fragments of the broken jaw during the healing of the part; stretching of any contractions and remoulding of facial contours; fitting of permanent appliances to replace lost parts, and so to preserve the facial outlines. The first end was achieved much more easily, of course, when the case was a recent one. In other cases metal "cappings" were applied to the teeth on each side of the break and adjusted in correct relationship by means of an expanding screw. Later a solid bar of metal replaces the screw and is soldered between the cappings. The splint is firmly cemented to the teeth and mastication is thus rendered possible.

This method was described in the journal of the Royal Army Medical Corps by several dentists who visited the French schools at the Val de Grâce, École Dentaire, No. 39 Auxiliary Hospital of the Croix Rouge and the American Ambulance at Neuilly.

The stretching of scars was possible because new "scar-tissue" is easily stretched and does not tend to contract again. Stretching was carried out by an ingenious arrangement of what were practically wedges of vulcanite driven in by degrees against the hard scar until the latter gave way before them. Artificial jaws made of vulcanite could then, if necessary, be made and placed in position. These artificial jaws naturally made all the difference in the patient's appearance, rendering his deformity negligible and ensuring for him that comfort of mind which must, in other circumstances, have been lost irretrievably.

Even more remarkable was the work accomplished in respect of other regions of the face. Indeed, this work had a dramatic quality. As the result of it, that which was unbearable to the eyes became once again normal in appearance and men were rescued literally from the very deeps of despair.

The method adopted in these cases was first to secure a good healing of the original wound and then to take a plaster mould. The skin is first oiled and then the plaster applied, and a few minutes later the cast is taken. Thereafter the procedure is as follows:

"The mould having been obtained, it is dried, french chalked, and a clay or plasticine squeeze is obtained from the mould giving a positive model of the patient's dressed wound and the

EVACUATION OF WOUNDED BULGARIANS BY THE GERMAN RED CROSS.

surrounding healthy tissues; this is fixed to a board on a modelling stand and a sitting from the patient with undressed wound is obtained. Modelling now commences and such art as the sculptor may possess is brought to the test. . . . The sculptor having completed his model, he proceeds to cast it and procures the plaster positive of the wound and its surrounding structures. Another sitting is obtained and the portions which are to be hidden eventually by the metal plate are modelled in clay or wax, the edges being blended to the uninjured portions of face, thus effectively masking any trace of wounds. This is once more moulded in plaster, and the edge of proposed plate being marked on the negative a cast is obtained, edges are trimmed to marking, and the model is ready to have the artificial eye fitted to the lids; this is done from the back of the model. The plaster eyeball is dug out, the requisite thickness of lids is carefully worked down, the glass eyes placed in position, and the edges of the lids made good with the plaster.

"The model is now taken to the electrotyper, where an exact reproduction by galvanoplastic deposit is made in virgin copper $\frac{1}{32}$-inch in thickness. This is finally well coated with silver. Thin bands are soldered in on the back to clamp the eye in place. . . . The final sittings are devoted to pigmentation of the plate. . . . The results of this work were good beyond the most sanguine expectations and proved how much can be accomplished given the will to achieve, infinite patience and a high sense of duty."*

EXERCISING THE ELBOW AND SHOULDER JOINTS.

Finally the French led the way in regard to the deformities caused by stiffness after wounds had healed. Early in 1915 the Grand Palais at Paris was converted into a hospital for the physical treatment of sick and wounded soldiers, among whom a very large proportion suffered from disabled limbs. The hospital included many separate departments, all under skilled medical direction, for baths, electricity, massage, movements (by hand and apparatus), and radiology.

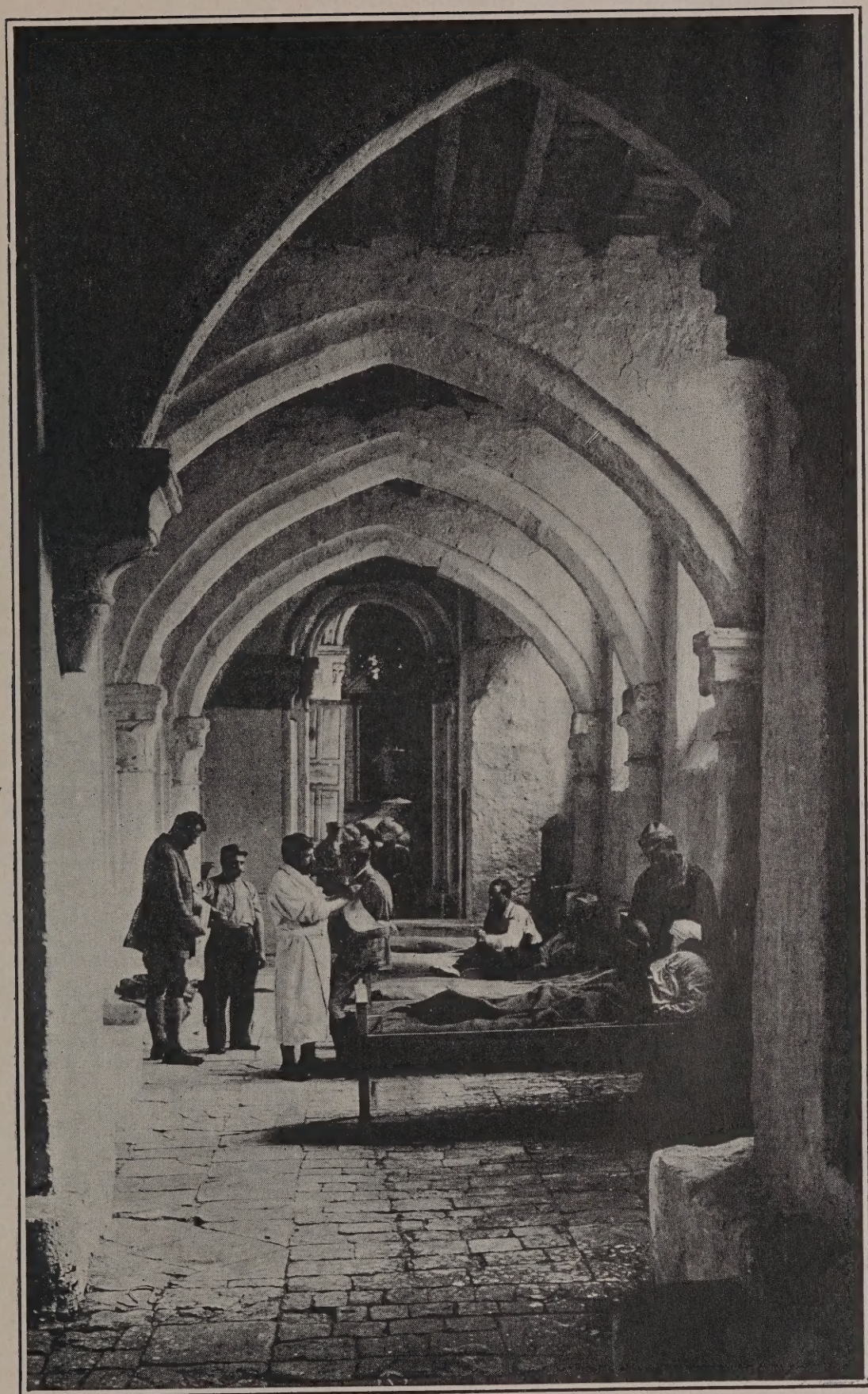
It was soon found that the apparatus which gave the best results was the so-called *eau courante* bath or "Whirlpool Bath." The object of this bath was to subject the injured limb to high temperature and moisture and continuous movement in a circular current of water. The motion might be that of a gentle stream or of a miniature whirlpool. The degree of heat varied from 104° to 122° F. —usually as much heat was administered as could conveniently be borne. The immersion was from 15–20 minutes daily.

The results of the use of this bath passed all expectations, and it was calculated that a huge sum, put as high as £80,000 per month, was saved the French Government in pensions. Men who appeared to be hopelessly crippled were relieved and often so far regenerated as to be fit for active service again. Milder cases recovered after short periods of treatment.

This work soon attracted attention, and a Committee of the Royal Society of Medicine, Balneological Section, went to Paris to investigate it. They reported in favourable terms, and efforts were made to have the treatment installed and begun in England.

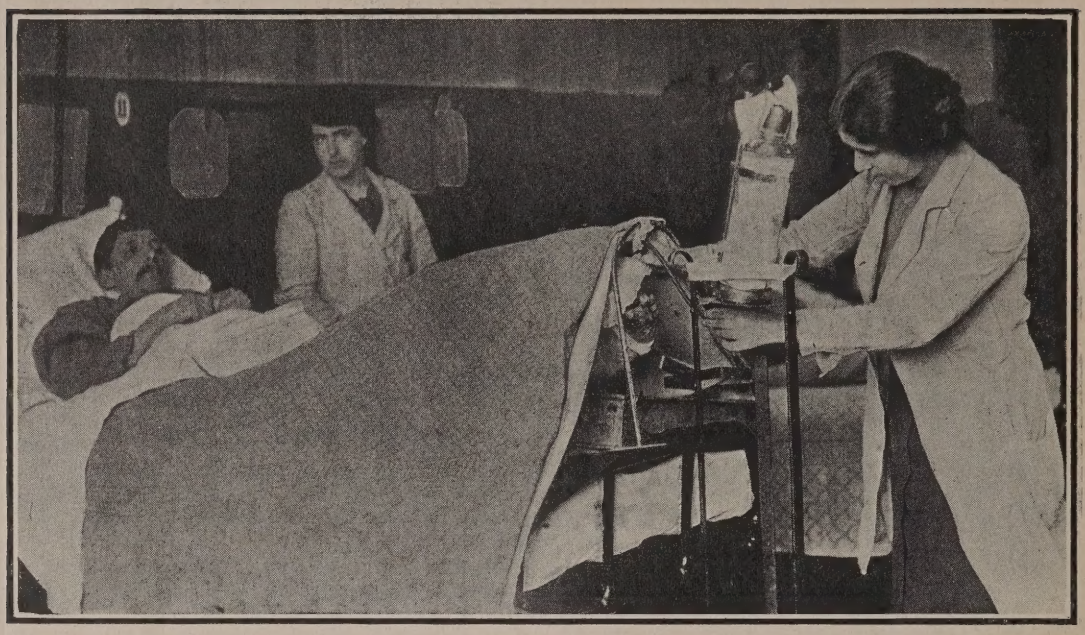
His doctor, therefore, followed the soldier back into ordinary life, and indeed did not relinquish care of him until, so far as human power could achieve, he had been returned to the full citizenship of his world. The horrors of war were thus mitigated in yet another direction and a guarantee given to the soldiers of the new armies that their well-being was the aim and object of a vast corps of highly skilled devoted men and women. The value of that assurance cannot be overestimated; it inspired

* (*Journal of Royal Army Medical Corps*, March 1916), Paper by Captains Richard Cruise and Somerville Hastings and Sergeant Derwent Wood, A.R.A.



A FRENCH FIELD HOSPITAL IN AN ANCIENT CHURCH.

In the aisle of a church, near the Aisne River.



TREATMENT OF TRENCH-FOOT.

a strong feeling of confidence, and it did much to lighten the sorrow and anxiety of those to whom the soldier's welfare was the chief consideration in life. When from time to time statements regarding these great advances were published, the utmost satisfaction was awakened in the public mind, which responded by an increased generosity towards auxiliary agencies of relief like the British Red Cross and the Society of St. John.

Thus the doctor influenced opinion at home as profoundly as he influenced it in the trenches. His days were full days and his work spread before him without limitation. His it was to choose the material of war in the light of war experience, to see that the material was brought to full maturity of preparation for the ordeal about to be encountered, to guard jealously the health, happiness, and comfort of the men who had given themselves into his hands, to inspire them with confidence in their hour of trial, to shield them from the small as well as the great troubles of campaigning, to build up between them and the unseen enemy, disease, a strong buttress, to heal them when fallen, and finally to win for them relief from the effects of their injuries. It will stand to the everlasting honour of these army doctors that they were worthy of this high calling. Through the long days of doubt and danger the mind of the soldier, ever bright and hopeful, was, indeed, the mirror of their labours and the measure of their achievement.

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